MOUNTAIN PINE BEETLE INSECT CONTROL HISTORY

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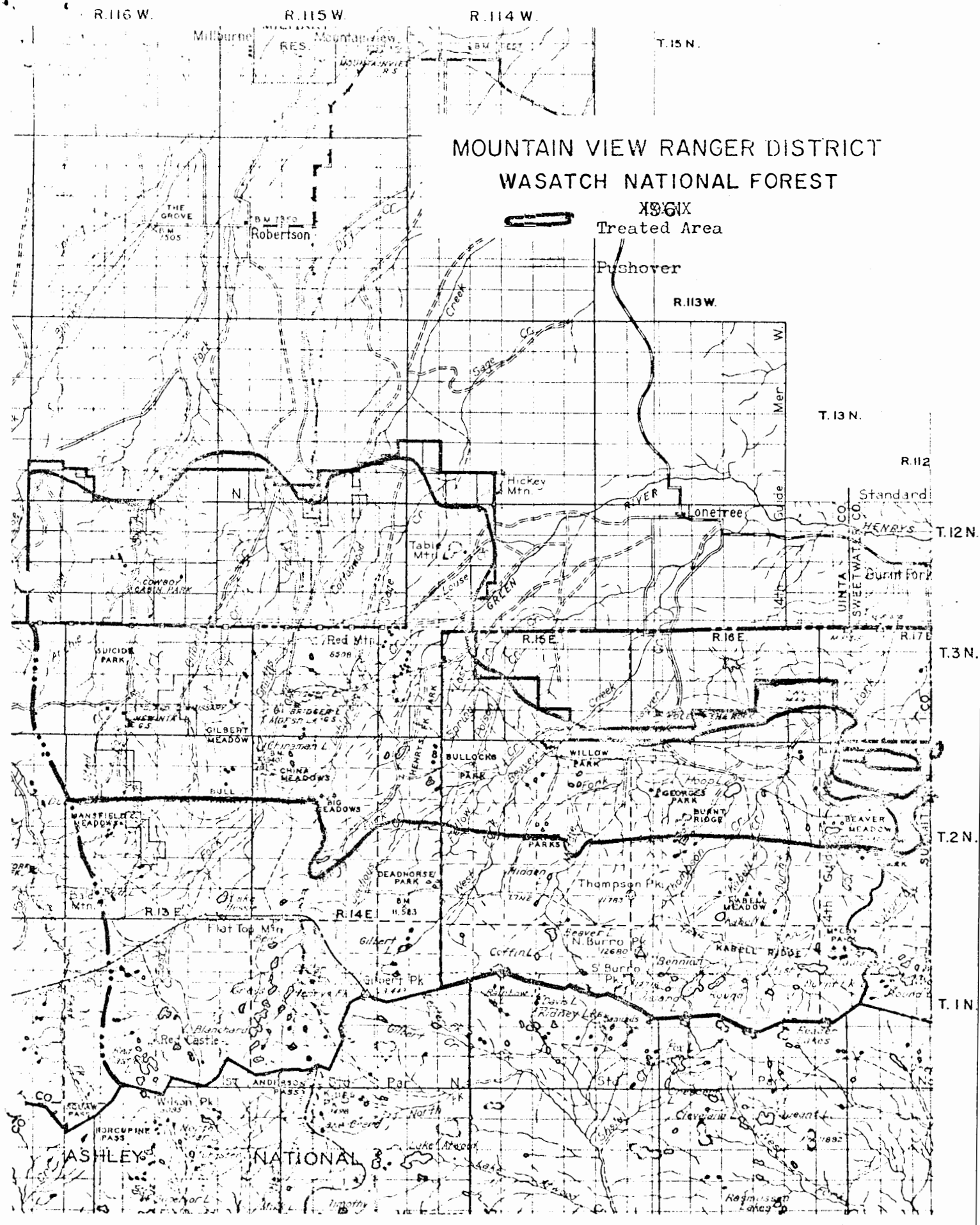
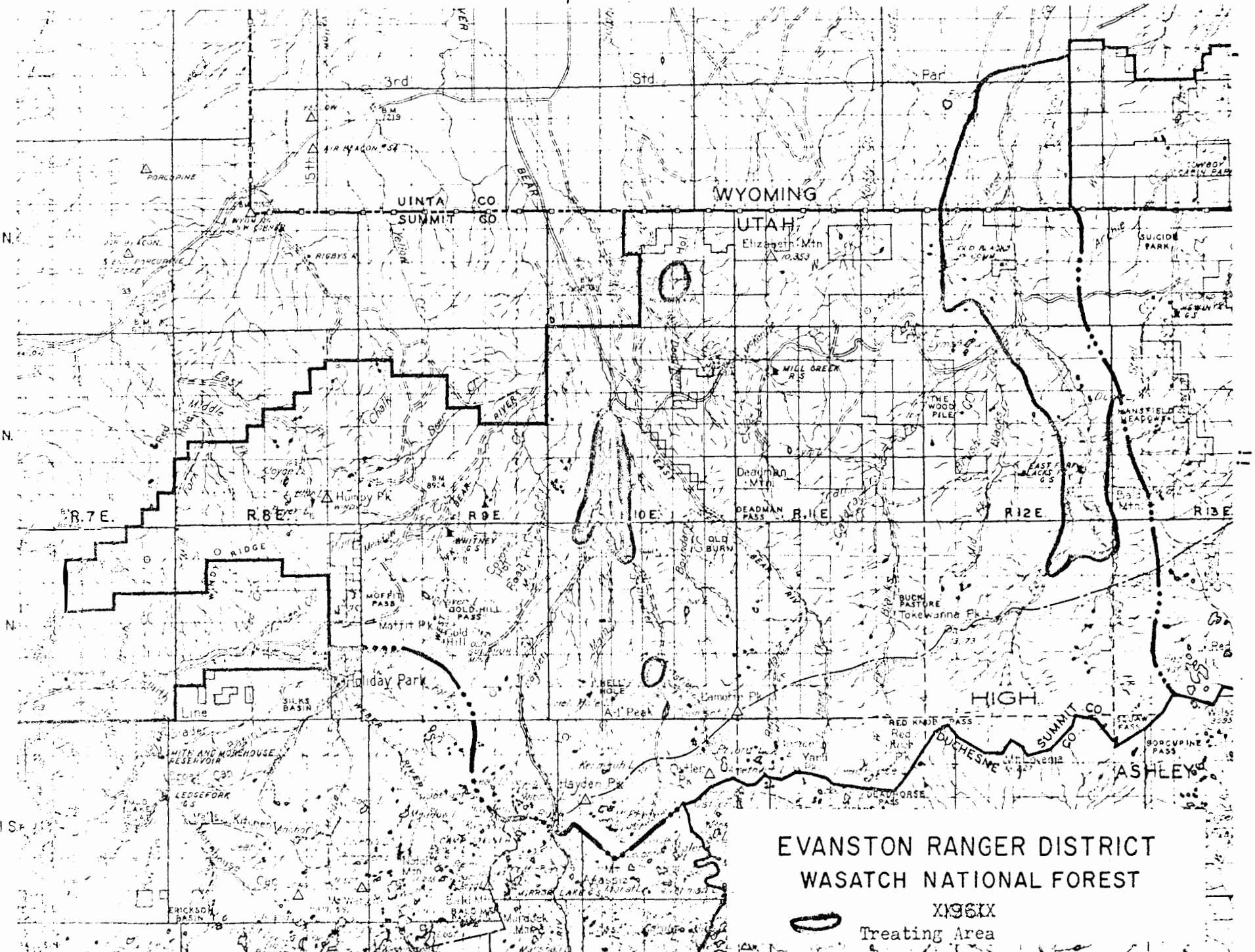
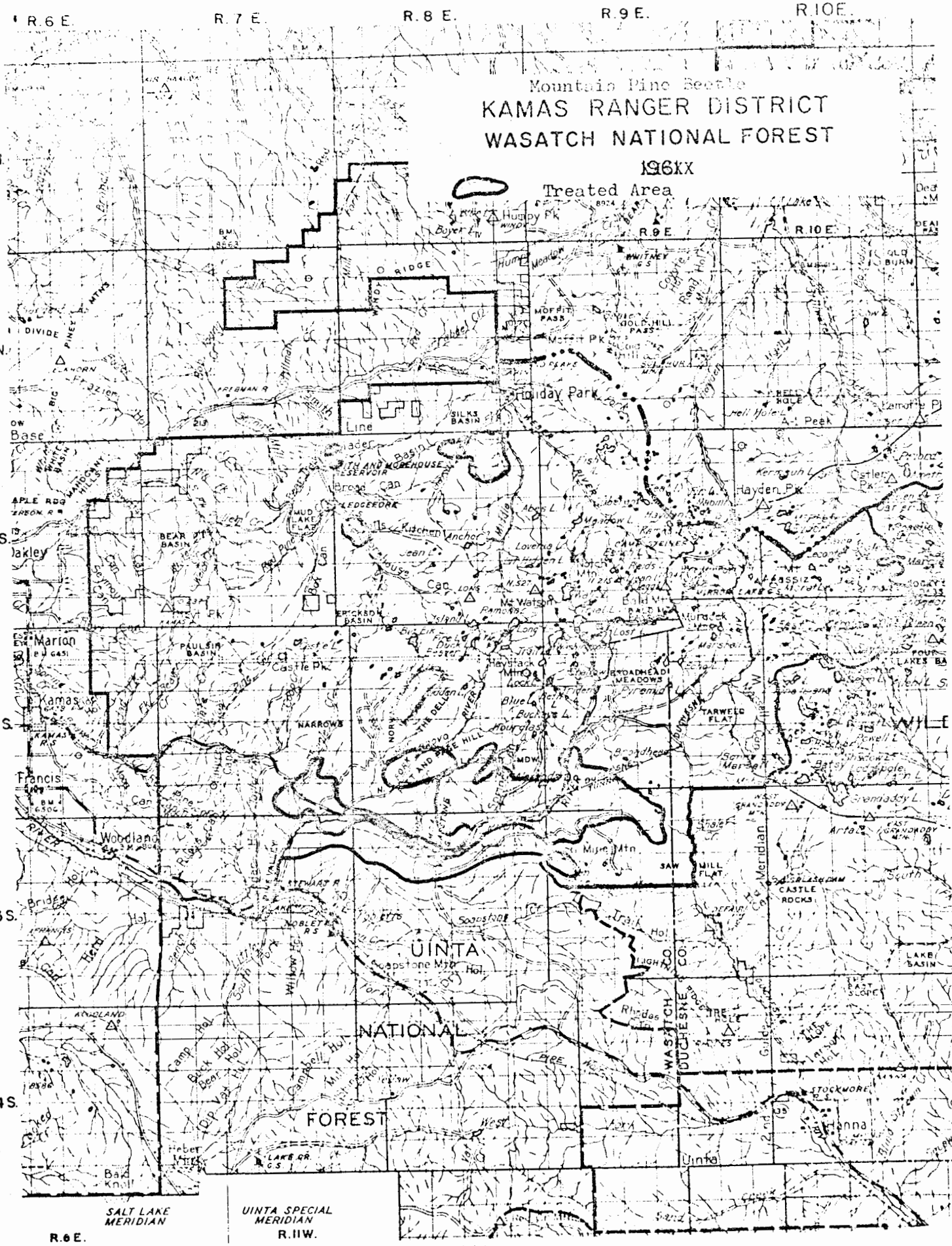

MOUNTAIN VIEW RANGER DISTRICT
WASATCH NATIONAL FOREST
1966
Treated Area
R.116 W.
R.115 W.
R.114 W.
R.113W.
R.112
T.15 N.
T.13 N.
T.12 N.
T.3 N.
T.2 N.
T.1 N.
R.13 E.
R.14E.
R.15E.
R.16E.
R.17E.
Millburne
Mountainview
RES.
Robertson
Pushover
THE GROVE
Hickey Mtn.
Table Mtn.
Onetree
Standard
Burnt Fork
Red Mtn.
SUICIDE PARK
GILBERT MEADOW
CHINA MEADOWS
BIG MEADOWS
MANSFIELD MEADOWS
BULLOCKS PARK
WILLOW PARK
GEORGES PARK
BURNT RIDGE
BEAVER MEADOW
DEADHORSE PARK
Thompson Pk.
KABELL MEADOW
KABELL RIDGE
Flat Top Mtn.
Gilbert Pk.
Coffin L.
N. Burro Pk.
S. Burro Pk.
Ridley Lake
Red Castle
Wilson Pk.
ANDERSON PASS
PORCUPINE PASS
ASHLEY
NATIONAL


To Evanston
WYOMING
UTAH
UINTA CO
SUMMIT CO
T.3N.
T.2N.
T.1N.
T.1S.
R.7E.
R.8E.
R.9E.
R.10E.
R.11E.
R.12E.
R.13E.
Elizabeth Mtn
10,353
Deadman Mtn
Hunpy Pk
Holiday Park
Hayden Pk
Mottit Pk
Gold Hill
Tokewanna Pk
Red Knob
Red Knob Pk
Lamoth Pk
A-1 Peak
Bald Mtn
Murdock Mtn
Kamas
ASHLEY
HIGH
DUCHESNE
SUMMIT CO
Smith and Morehouse Reservoir
Ledgefork
Wells
Kitchen
Erickson Basin
Silks Basin
Moffit Pass
Gold Hill Pass
Deadman Pass
Red Knob Pass
Porcupine Pass
Suicide Park
Mill Creek
The Wood Pile
Buck Pasture
Old Burn
Whitney
Hell Hole
Ridge
Line
Rigbys
Porcupine
Beaver
Yellow
Chalk
Dead Horse Pass
EVANSTON RANGER DISTRICT
WASATCH NATIONAL FOREST
XIXIX
Treating Area


Mountain Pine Beetle
KAMAS RANGER DISTRICT
WASATCH NATIONAL FOREST
196XX
Treated Area
R.6 E.
R. 7 E.
R. 8 E.
R. 9 E.
R.10E.
T.2N.
T.1N.
T.1S.
T.2S.
T.3S.
T.4S.
Kamas
Marion
Francis
Woodland
Oakley
Hayden Pk.
Castle Pk.
Holiday Park
Mt. Watson
Mt. Marsh
Mine Mtn.
Hanna
UINTA
NATIONAL
FOREST
WASATCH
CACHE
Meridian
SALT LAKE MERIDIAN
UINTA SPECIAL MERIDIAN
R.6E.
R.11W.

INTRODUCTION

The Wasatch National Forest has approximately 300,000 acres of commercial timber land, of which 77 percent or 254,000 acres is lodgepole pine type. From timber survey data, it is estimated that the annual allowable cut is about 25 million board feet. It is estimated that a total of 3.3 billion board feet of lodgepole pine sawtimber was threatened on the Wasatch and Ashley Forests by the epidemic of the mountain pine beetle on the North Slope of the Uinta Mountains.

During the early stages of infestation, timber loss was in the large diameter class trees. As the epidemic increased, smaller diameter classes were lost. See Tables 9 and 10 in appendix for estimated resource loss and volume loss by diameter classes.

The value of a panoramic view of green timber stands, or the value of trees for beauty or shade in a developed recreation area, cannot be measured in monetary terms; but the value placed on this resource by the public is extremely high. This is amply expressed by the one-half million recreation visits along the Mirror Lake Highway in 1961. This resource is obviously being damaged due to the death of trees caused by insect activity.

The Wasatch National Forest has a long history of mountain pine beetle infestation. Existing records indicate some timber loss has occurred every year since 1920. From 1920 the infestation increased at an alarming rate, so that in 1931 the first control program was started. During the period from 1931 to 1936, 140,000 trees were treated. During this period, a program of girdling large, rough, overmature trees to prevent future epidemics was carried on. Records of the number of trees or acres involved are not available, but recent survey data reveals that a large area on upper Gilbert Creek and the West Fork of Smith's Fork were treated in this manner.

There was no further treating done on the Wasatch Forest until the present program was initiated in 1958, even though records indicate that a flare-up of insect activity occurred during the period 1948 to 1950. After this, the beetles were relatively inactive until 1953, when a definite increase began and has continued until the present time.

During the summer of 1956 an aerial insect detection survey was made of the North Slope of the Uinta Mountains on the Wasatch and Ashley Forests by personnel of the Forest and Range Experiment Station. This was followed up in 1957 by an intensive ground survey which indicated that there were approximately 100,000 infested trees in the area. This survey verified the epidemic condition that existed and led to the control program which began in 1958.

TREATING - 1957-1965

Based upon the 1957 survey findings, a control program for the mountain pine beetle on the North Slope of the Uinta Mountains was initiated in the spring of 1958. Due to the limitations on financing and based upon recommendations by entomologists, the plan was to treat the area from east to west beginning on the east end of the infestation along the Wasatch-Ashley Forest boundary. This action was taken to stop the spread of the infestation toward the Ashley Forest with the prevailing wind. It was felt that the infestation would not spread toward the west during the period of control.

The control action on the east end of the infestation in the Hole-in-the-Rock areas was successful in stopping the eastward movement of the infestation. It also reduced the population to a point where the need for treating approximately 16,000 acres of previously heavily infested area was eliminated in the fall 1960 - spring 1961 period. As the project progressed, treating in the Hole-in-the-Rock Unit and part of Dahlgreen was reduced to a maintenance basis on limited areas with less than one infested tree per acre. The assumption that the infestation would not spread toward the west during the period of control was correct; however, there was an alarming build-up of the beetle population along the western edge of the infestation. To cope with this, additional forces and methods of treating were used.

Past control methods included offering timber sales in the infested areas. Sales for 30 million board feet were offered twice and for 55 million board feet once. These sales failed to attract bidders.

Small sales were made in the infested areas. This reduced the amount of control work needed.

From 1958 through July 31, 1965, the Wasatch National Forest treated 734,141 trees on 420,986 acres for an average cost of $5.84 per tree and $11.07 per acre. Many acres were treated more than once. In addition, 774,861 acres were surveyed. Summary table follows.

Many new methods of treating trees, infested with mountain pine beetle, were tried in an effort to develop a cheaper and more effective treating method. Each of these methods has certain advantages and disadvantages, whether they are accomplished by Forest Service crews or by contracts.

Briefly, the methods used on the Wasatch were: burning the standing infested trees with flame thrower guns; felling the trees, then burning, or peeling off the bark; pushing over or chaining heavily infested stands, then piling and burning; spraying the standing trees with a chemical insecticide; and removing the infested trees from the forest by logging.

TABLE I

SUMMARY OF WASATCH NATIONAL FOREST
INSECT CONTROL ACCOMPLISHMENT 1958 - 1965

	Insect Survey Information		Treating Done		
CY	Number Of Acres	Number Of Trees	Acres	Trees	Trees Per Acre
1958	123,964	130,952	42,000	52,554	1.25
1959	57,998	161,971	39,760	75,064	1.89
1960	80,340	160,166	37,199	165,314	4.45
1961	123,964	304,611	29,594	155,401	5.26
1962	144,671	337,391	90,027	190,542	2.12
1963	104,161	50,147	107,867	81,388	.74
1964	130,823	30,682	39,498	12,561	.34
1965	7,630	3,910	35,030	3,419	.10
1966	1,310	1,844	--	--	--
Total	- - - - - - - - - - - -		420,975	736,243	--

CY	Cost Per Acre	Cost Per Tree	Total Expend.	Force Acc't. Man Days	Man Hours Per Accident
1958	13.69	10.94	$ 575,207	7,500	12,011
1959	12.51	6.62	497,316	10,900	6,732
1960	16.87	3.80	627,621	16,400	3,451
1961	27.63	5.26	817,789	23,700	4,622
1962	7.35	3.15	1,063,713	20,000	6,679
1963	4.95	10.28	515,493	12,100	3,726
1964	1.25	5.34	163,909	3,500	9,314
1965	1.61	16.46	56,265	1,407	11,256
Total			$4,317,313	95,507	Avg. 5,064

(For further details concerning the subject of Table I, see Table II, Table III, and Table XI (in the Appendix). Table XII covers trees and acres treated by ranger district each calendar year.)

In comparing force account and contract treating, cost of treating is a major point to consider. However, additional factors which must be considered are the effectiveness of treating and the problems encountered in supervising and checking contract work. Treating by the two types of crews is discussed below.

Contract treating has resulted in a lower cost per tree treated than force account treating. This cost advantage results in part from the large expenditures that are necessary to construct camps, to move men from camps to the working areas, to house and feed the force account crews, and the increased overhead costs to employ, supervise, and payroll, these crews. The areas of highest infestation density were contracted. Normally, the more infested trees treated per acre, the lower the cost per tree.

In comparing contract with force account work, the cost of contract administration as well as the "bid price" must be considered. Regardless of the method of treating used, this is a substantial cost.

Further, the quality of work done under contract treating has not been as effective as that done by force account crews. This failing can be corrected by closer supervision and checking of contract crews. This, however, increases costs.

Force account treating has resulted, with better training and supervision, in a higher quality treating than contract treating, and in turn has decreased the need for re-treating. The reduced cost of re-treating more than offsets the apparent cost advantage of contract treating. The difference in force account and contract treating will decrease as the high fixed cost of camp construction is amortized over a greater number of treated trees. Force account treating usually results in the best combination of cost and effectiveness.

In order to keep the project efficient, it was necessary to use both force account and contract crews. For cost analyses see Table III and Table XI.

Explanation of Treating Methods

Standing Burning. This is one of the oldest methods of treating insect infested trees. Standing burning was used extensively on insect control projects in the 1930's. It consisted of spraying fuel oil on the infested

trees with hand pumps and setting the trees on fire. Sometimes brush was piled around the trees to create a hotter blaze.

The Standing Burning method using flame throwers was first used on a trial basis in the fall of 1960. The method now consists of spraying a low grade fuel oil under 200 pounds of pressure through an orchard spray gun past a burning wick where it is ignited. The flame produced is very hot and rapidly scorches a tree.

In the spring of 1961 this method was used on road rights-of-way and other areas easily accessible by jeeps. A total of 2,037 trees on 148 acres were burned until the weather was such that numerous spot fires occurred, and burning had to be abandoned. In the fall of 1961, the burning units were towed through the forest by small crawler tractors. During this period, 5,180 trees were treated on 300 acres.

It has been shown that burning standing trees can be very economical; the effectiveness of the method is questionable. This method is limited to areas that are relatively flat (less than 20% grade), and areas that do not contain thick stands of doghair or heavy concentrations of fallen timber. An infestation intensity of 10 trees per acre or more is desired in order to utilize the potential of the burning units and remain efficient. Severe scorching damage is sustained by trees adjacent to burned trees. Problems have developed with infestation of scorched trees and insufficient kill of larvae during mid winter. Burning during windy weather has given poor larvae kills on the upwind side of the tree. Standing burning is not recommended without further study of side effects and effectiveness.

Felling and Burning or Peeling. This method also was used extensively in the past. Felling and burning had only limited use on the present operation. Treating consists of felling the infested trees, bucking them into smaller lengths, piling, and burning. When burning conditions are such that burning fuel is not needed to insure a proper burn, then burning should be stopped because of the fire hazard. This method was used only during the 1961 season; 1,773 trees on 206 acres were treated. Of this total, 753 trees on 70 acres were treated by contract and 1,020 trees on 136 acres by force account. Contractors are able to do a better job of felling than force account crews due to their familiarity with chain saws.

Felling the infested trees and peeling off the bark has only been on a trial basis by force account crews. A total of 95 trees (these trees are included in felling and burning total) have been treated by this method. The cost of this trial was inexpensive but extremely slow. Housing the number of men required for a full scale peeling job would be prohibitive on the North Slope.

Chaining and burning. The use of chaining and burning as a means of controlling insect epidemics is entirely new, having been used only on the Wasatch National Forest. This method was used on an area where the beetle population had exploded. In certain areas, the infestation intensity was over 100 trees per acre, and in all areas treated by this method, the intensity was over 20 trees per acre.

"Operation Pushover," which is the name applied to this treating method, consisted of linking two large tractors (TD-25's) together with 150 feet of heavy anchor chain. As these tractors moved along in parallel paths, they flattened the trees in the swath between them.

After the trees have been knocked down and uprooted by the chain, bulldozers systematically piled the trees into windrows. These windrows were spaced approximately 1½ to 2 chain intervals with staggered spaces along the windrows about every 500 feet for escape routes while burning.

Prior to burning, a written prescribed burning plan was approved, and during this entire phase it was followed in great detail. Burning was done by pressurized flame thrower guns similar to those used on standing burning. The windrows were ignited from the down-wind end, and the burning crews would work into the wind, thereby preventing their being overcome by the smoke.

After the initial burning, it was usually necessary to repile and burn a second time to eliminate any trees that might not have been scorched sufficiently to kill the beetles during the initial burning. Also, the repiling and burning accomplished a clean-up of the area. It also removed almost all potential impediments to any further mechanical site regeneration measures. Additional repiling was done on some units to clean the area of blackened logs. The third piling and burning left a site open to wind scouring, hindered reproduction, and is not recommended.

On an area of 204 acres where there was a possibility that erosion would occur because of terrain, erosion control was accomplished by the use of contour terraces.

This "pushover" area and method of treatment was chosen for these reasons: (1) the heavy infestation intensity required a faster and more economical method of control; (2) the estimated value of the timber destroyed was rather slight because the merchantable timber had already been destroyed by the beetles; (3) the terrain was relatively flat and no serious erosion problem would occur; (4) the area contained very little recreational or esthetic value; (5) no running streams passed through the area; and (6) conditions for regenerating a new and better timber crop after treatment were favorable; (7) the extensive forest of snags would be removed; (8) retreatment would not be necessary.

On a given area of chemical treatment, the retreatment job amounts to approximately 1/4 to 1/3 the original number of trees. Retreatment is usually accomplished in the subsequent two insect life cycles. "Pushover" avoids this retreatment. Since the resultant savings can only be estimated, they are not reflected in our cost tables.

An analysis of the costs of the "pushover" phase reveals that costs could have been reduced considerably if broadcast burning were used instead of the intensive piling, repiling, and burning operation. These three phases represent 54 percent of the net costs of Operation Pushover.

Because of the possible adverse public reaction to the heavy accumulation of debris after broadcast burning, the more expensive piling, repiling, and burning method was used. (See Table VI for cost data.)

Regeneration studies in 1961 found that on the areas chained in the fall of 1960, seedling establishment of lodgepole pine occurred on 79 percent of the plots sampled. Each plot was 0.004 of an acre. It is felt that regeneration on fall pushover is more than adequate at the present time. On areas that were pushed in the spring of 1961 reproduction is poorer. With frost heaving, winter dessication, and other losses, some areas were inadequately stocked in 1963. In 1963 and 1964, 1,162 acres were seeded on a 7 x 7 foot spacing and 40 acres were planted with seedlings.

Treating by pushover in the fall of 1960 and the spring of 1961 destroyed 83,469 infested trees on 1,778 acres. Pushover was discontinued on the project for two reasons: (1) the adverse public reaction that could take place and (2) the lack of knowledge among foresters and ecologists as to what the large exposures created will do to the micro-climate, other ecological factors, and to the tree regeneration.

In infestations where no economic residual stand would be left, chaining followed by broadcast burning is the least expensive method of control.

Chemical Treating. Of the methods tried, spraying infested trees with ethylene dibromide (EDB) was used most extensively because it gives the best combination of speed, effectiveness, and economy on any type of terrain. This method was not fully appreciated. In making treating plans, the other methods were usually given priority because they must have certain requirements in order to remain efficient. Although chemical treating was done on all the less desirable areas where there were scattered trees and rugged terrain, it still remained an economical method. Treating areas of heavier intensities by the chemical method would reduce the cost per tree to compare with the cheaper methods.

During the early stages of the project, the chemical used was a concentrated mixture of EDB, emulsifier, and oil added to water. This was

mixed in a ratio of one gallon of concentrate to four gallons of water. During early spring and late fall, when temperatures dropped below 40° Fahrenheit, the emulsifier and water were eliminated and replaced with oil to prevent freezing of the insecticide. During 1958 and the spring of 1959, the taller trees were felled to allow treating of the infested portion of the top which could not be reached while spraying the standing trees. Felling was eliminated after spring treating in 1959 because of the large area needing treating and the limited financing. It was determined that by eliminating felling, a reduction in the cost per tree and an increase in numbers of trees and areas covered were possible. An increase in the overall effectiveness of the program was thus accomplished. Insects in tops that were not treated were picked up in the follow-up treating the next season. In 1965 benzene hexachloride was used with a one-man mist blower on terrain too steep for horses. Only a pint of spray was needed per tree. Thus the men were able to carry their own insecticide. This method will be used for treating steep areas in 1966.

Logging. Proposed timber sales were part of the plan to control the beetle by utilization of the overmature timber. Due to the depressed lumber market and other reasons, private operators failed to bid on any of the large sales offered. This has resulted in a large quantity of timber being destroyed that could have been utilized. In an attempt to alleviate this situation, logging by force account was tried in the fall of 1961 with the following three objectives in mind: (1) control of the mountain pine beetle, (2) utilization of the timber resource, and (3) a search for a more economical method directly to control the beetle.

The Forest Service performed the following phases of trial logging operation: (1) access and spur road construction, (2) marking, (3) felling and limbing, (4) skidding, and (5) decking. The 480,000 board feet produced by this project were offered for bid and sold in the decks for $8.80 per thousand.

With this net cash return from the sale of infested timber, it was thought that logging might be one of the more economical treating methods. However, this proved to be more expensive than other methods of treating. The only benefit derived over the other methods was that of possible timber utilization. The operator did not move these logs even with a one year extension of the contract. These decks were burned by force account crews in July 1963. Heavy broods remained in the lower logs.

Logging costs far exceeded the return from stumpage. This was due to: (1) the low appraised value, (2) lack of bidding above the appraised price due to poor market conditions, and (3) the extremely high cost of logging.

Factors influencing the low appraised price were: (1) the decked timber was to be hauled 10 miles from any lodgepole stand by June 30, 1962; (2) this short term requirement forced the buyer to haul under adverse weather conditions; (3) approximately 15 percent of the total volume was cull material that would be either cut out of the decked logs and burned, or hauled to the mill site.

Factors influencing the high cost of the logging operation were: (1) the selective type cutting which averaged 40 infested trees per acre in a stand which averaged 250 stems per acre, (2) the small log size, (3) the necessity of using unsuitable sized tractors which were available, (4) lack of experienced help, (5) excessive travel time for force account crews, (6) the initial high cost of purchasing logging equipment, (7) adverse weather conditions, (8) camp and overhead costs, and (9) the high cost of access to the area per thousand board feet.

Although the entire objective was not accomplished, 10,459 infested trees were treated on 262 acres. Table III gives a summary of treating methods by cost elements.

SURVEY

The initial aerial survey was started in 1956 and the first intensive ground survey was made in 1957. Every year since, a ground survey was made of the North Slope of the Uintas. In 1961 and 1962 intensive ground surveys were made in the Kamas District and in the Stillwater area of the Evanston District.

From 1957 through 1959, the system of survey used was the line-plot cruise method. The survey procedure was to establish 1/5 acre circular plots every two chains along cruise lines. Cruise lines were spaced at 20 chain intervals for a 5 percent cruise, and at an 80 chain interval for a 1¼ percent cruise. Current infestation activity was recorded on every plot. On every tenth plot, all trees--both green and those which had been insect filled--were recorded. This provided information on the percent of total stand loss by diameter classes due to beetle activity. (Refer to Table I).

In 1960 the method of survey was changed from a line-plot cruise to a strip cruise. It was felt that areas of infestation could be more accurately located and that a higher degree of survey accuracy could be obtained. The strip cruise consists of recording the desired information on a continuous strip, 16.5 feet wide. The percent of cruise desired is obtained by varying the distance between strips. Strips ran at 5, 10, or 20 chain intervals and gave a 5, 2½, and 1¼ percent cruise. An analysis in 1961 found no statistical difference between a 5 and 2½ percent cruise. Generally, anything less than a 2½ percent cruise contains too much variation in the results to be acceptable for contracting. In 1962 a line-plot cruise was used on the North Slope in Wyoming, and due to insufficient funds a reconnaissance survey was made on the Utah side. For planning purposes the two survey methods gave information of equal value. The initial 1963 and 1964 surveys were all reconnaissance. Experienced men can get the best results with this method. It is also the cheapest way.

The 1958 survey included only a small portion of the Gilbert Creek area (4800 acres) and none of the Hewinta area. In 1959 all of the Gilbert Creek area was included in the survey, but again Hewinta was left unsurveyed. As a result of previous treating, there were some variations in acres surveyed in various units. The intensive 1961 fall survey is believed to be the most complete and accurate up to 1961. The 1962 survey results were extensive but came close to actual trees infested. Subsequent surveys were close in total tree number, but figures on individual areas were poor. A comparison of survey information up to 1961 with actual treating figures shows that survey figures were consistently low. The survey showed more trees in 1962, 1964, and 1965 than the crews could find. Winter kill accounted for most of the difference.

Errors in survey information are in part due to the following: (1) the survey is run while some of the beetles are still flying; (2) there is a good possibility of missing "blind attacks" and other infested trees; (3) errors are made in pacing and in using the compass; and (4) the survey was not the proper size to achieve adequate sampling.

Early survey data is necessary for planning fall projects. Surveys have been started as early as the entomologists would permit. Often this early survey has resulted in surveying areas before full infestation was completed. To alleviate this problem, a post-survey on selected lines was run in 1961.

The post survey consisted of selecting permanent transect lines in various localities at the beginning of the survey. As the crews surveyed these transect lines, they sprayed the infested trees with paint and recorded them by strips. After the beetles had completed their flight, these same lines were run again and all the trees that had been attacked since the initial survey were recorded. This data was used to determine a correction factor, which was then applied to the early data.

All these methods of survey and treating were developed over eight years of treating, which cost over 4 million dollars. (See Table II) The cost of the various methods of treating are broken down into "cost elements" on Table III and Table XII. Table IV explains discrepancies between II and III.

Explanation of Cost Elements. "Net Cost of Treating" includes all costs that are required "on the ground" to treat the trees. This includes salaries, camp operation costs, subsistence, vehicle and equipment expense, field equipment costs, field overhead, insecticide, and burning fuel.

The column on "909 Assessment" represents the prorata share per formula calculations of the costs incurred by the Supervisor's Office for transacting the necessary business generated by the insect control work load. This is prorated into the different treating methods by total costs.

"Evaluation and Planning" includes all the cost that has occurred during the non-treating seasons for personnel hiring, evaluation of results, and planning for future projects.

"Project Overhead" includes the salaries, vehicles, travel, and subsistence of all personnel designated as overhead while the project is running. This is prorated to the different treating methods by man-hours worked in each.

SUMMARY OF TREATING METHODS BY COST ELEMENTS*

Treating Method	No. of Trees Treated	Acres Treated	Net Cost of Treating	909 Assessment	Evaluation & Planning	Project Overhead	Camp Const. Maint & Sec.	Road Const. & Maint.	Total Cost of Operation
Chemical Force Account	389,862	288,123	76% $2,088,156	6% $175,500	3% $72,966	3% $76,814	9% $248,731	3% $71,777	100% $2,733,944
Chemical Contract	220,669	124,777	87% 851,709	4% 46,360	1% 11,203	2% 18,745	3% 26,611	3% 28,490	100% 983,118
Burning Stand Force Account	18,931	3,083	85% 64,547	4% 3,265	2% 1,443	5% 3,866	2% 1,276	2% 1,238	100% 75,635
Pushover Force Account	83,469	2,443	71% 200,528	4% 12,509	3% 8,851	7% 18,162	6% 15,862	9% 25,471	100% 281,383
Logging Force Account	10,459	262	64% 39,000	8% 4,713	1% 753	4% 2,564	5% 2,690	18% 10,958	100% 60,678
Fell & Burning Force Account	1,346	229	80% 5,984	6% 425	1% 78	2% 148	8% 681	3% 239	100% 7,555
Fell & Burning Contract	11,507	2,723	93% 55,498	2% 1,310	1% 707	2% 1,085	1% 659	1% 534	100% 57,793
Survey	--	--	17% 19,835	7% 7,823	54% 63,807	6% 6,694	13% 15,089	3% 3,959	100% 117,207
TOTAL	736,243	420,975	$3,323,257	$251,905	$159,808	$128,078	$311,599	$142,666	$4,317,313
Cost/Tree			4.52	0.34	0.22	0.17	0.42	0.19	5.86
Cost/Acre			7.89	0.60	0.38	0.30	0.75	0.34	10.26
Percent of Total			77.0%	5.8%	3.7%	3.0%	7.2%	3.3%	100.0%

For more detail: These costs are shown by years on Table XII of the Appendix.
*Explanation of cost elements found on preceding page (11).

The cost of "Camp Construction, Maintenance and Security" is prorated into the treating methods by the number of men per year per method living in camp.

The column on "Road Construction and Maintenance" includes all costs incurred for this purpose which includes tractor costs and the operators' salaries and subsistence. It is prorated into the different treating methods by net cost of treating for that particular year.

Analysis of Cost Keeping Methods

Insect Control cost recording was changed from the fiscal year form to a form which shows costs by calendar year. This has several advantages: (1) it matches the form of the final Insect Control Accomplishment report; (2) it enables any person reading the historical records to follow easily the cost analysis by treatment and methods, and (3) it follows a logical sequence where the treating is completed fully during one cycle of business. This method has one disadvantage in that the project funds are obtained on a fiscal year (July 1 to June 30) basis. This entails an adjustment to obtain calendar year costs. If insect control funds were allotted on a claendar year basis instead of a fiscal year basis, the financial setup would be greatly simplified and would follow the normal complete cycle of business: spring planning, opening camps, construction of installations (as needed), spring treatment, closure of camps and necessary maintenance of installations during the period while the beetles are in flight, spring evaluation and fall planning, fall treatment and survey, camp closure for winter, fall evaluation, and the final Insect Control Accomplishment Report submitted.

The present breakdown of costs allows a person to study the actual net costs of various treating methods, which show salaries, vehicle and equipment rental costs, cost of treating ingredients, meals, camp operation, operational overhead, and purchases necessary to carry on the treatment. The individual treating methods break each of these costs out on a cost-per-tree and-acre basis which allows a study into the effect each element has on the treating methods. Planning and Evaluation; Camp Construction, Maintenance, and Security; Road Construction; Project Overhead; 909 Assessments; and adjustment of overexpenditure in the previous business cycle, if any, are then added to the net cost of the treating method to arrive at a gross cost. This total agrees with the Insect Control Operating Plan.

Under the accounting procedures in use, expenditures are charged against the current year's treating. Therefore, when camps are built or large expenditures for equipment made, cost per tree is higher for that year. Subsequent years' treating are then cheaper because the cost is written off.

TABLE III - ANALYSIS OF TOTAL COST PER TREATED TREE BY COST ELEMENTS--1958-1962

Cost Elements		Percent of Total
Treating Cost	4.276	76.0%
909 Assessment	0.304	5.5%
Evaluation & Planning	0.193	3.5%
Project Overhead	0.159	2.8%
Camp Const., etc.	0.456	8.2%
Road Const., etc.	0.218	4.0%
	$1.00 $2.00 $3.00 $4.00 Cost Per Tree	100.0%

Analysis of Pushover Costs

Because "Operation Pushover" was a unique method, the costs for this type of treating are listed below by operation on a tree-and-acre basis. As pointed out above in survey, the cost-per-acre basis is a better picture of what this method actually costs than the cost per tree (refer to description of pushover under treating methods). Acre costs do not change with infestation intensity.

TABLE IV - BREAKDOWN OF NET PUSHOVER COSTS (COMBINATION OF CY 1960 AND CY 1961)

Operation	Net Cost/Tree	Net Cost/Acre
Block Layout	$ .09	$ 4.43
Chaining	.39	18.06
Piling	.82	38.61
Burning	.44	20.49
Re-piling	.53	24.84
Re-burning	.10	4.50
Erosion Control	.02	1.04
Roads	.28	13.29
*Total Treating Cost	$2.67	$125.26

*Cost-per-tree and -acre do not agree with the costs shown in Table IX because the above costs are a net cost of operation and do not include the other cost elements included in Tables IX and X.

DEVELOPMENT AND USE OF PROJECT PROCEDURES

Stringlining and Spotting

Gridding the project with string each season provided control for the crews. Strip width varied from two to eight chains. The project began with four-chain wide strips. Some crews did a more accurate spotting job with narrower strips; therefore, for uniformity, strips were narrowed to three chains for a six-man crew in dense going. Strips were widened the last three years to allow more acreage of lightly infested forest to be spotted.

With the spotting of fewer trees, the project treating period was moved to a later date. Late spotting of faded trees allowed wider string lines and faster spotting.

Prespotting

In the spring of 1961, spotting and treating on all force account treating was done by separate crews. This "pre-spotting" was initiated for the following reasons: (1) it was necessary to pre-spot the areas where tractor treating was to be done in order to establish the exact area to be treated by this method; (2) it was felt that spotting with a special well-trained crew would result in fewer infested trees being missed; and (3) by pre-spotting, mapping the trees spotted, and furnishing the treating crews with the maps made, it was felt that more trees could be treated per crew.

By the fall of 1962, 190,639 trees on 83,524 acres had been pre-spotted at a cost of $.69 per tree and $1.58 per acre. These costs include the cost of stringlining when done in conjunction with spotting.

The pre-spotting crew consisted of four men - a strawboss and three crew members, with the strawboss doing the mapping and recording. The procedure followed is given below.

The stringlines are tagged at five-chain intervals for use as reference points in mapping. Three crew members do the actual spotting and marking of the trees. Marking is accomplished by an axe blaze and crayon number.

The strawboss records the trees spotted on a recording sheet reproduced to scale, showing stringlines and five-chain interval marks. A copy of the recording sheet is then given to the treating crew to use in treating the area. This system was expected to increase the efficiency of the treating crew: (1) by allowing them to bypass areas which contain no infested trees, (2) by allowing the strawboss to plan his day's treating to keep walking times to and from the actual area of

work at a minimum, and (3) by allowing better planning on the distribution of insecticide, thereby eliminating nearly all instances of crews being held up while waiting for spray.

The advantage of prespotting is the ease of training picked men to do the spotting job. On a large project, it is a costly and difficult job to make every member of a treating crew a good spotter. By using the prespotting technique, it is possible to screen the work force and train only those who have the best capabilities to do the spotting job. The other individuals are put on treating work, which requires less ability and less training.

In practice, prespotting was not efficient. Treating crews could not make better time and the benefit of prespotting was lost in trying to locate spotted trees.

Insecticide

During the eight years of treating on the Forest, the methods of mixing insecticide and its distribution to the field have undergone several changes.

The mixing of a concentrate consisting of ethylene dibromide (EDB), No. 2 burner oil, and emulsifier was originally done for the project at a central mixing dump at Hole-in-the-Rock. This concentrate was then measured into a five gallon jeep can and water added to dilute the insecticide to the specified strength. In cold weather, burner oil was used instead of water to prevent freezing. All of the ingredients used in the insecticide were purchased separately, with the EDB and emulsifier being delivered in 30 or 50 gallon barrels and the oil in bulk. The three were mixed to make concentrate which was hauled to the field in drums. To make insecticide, a gallon of concentrate was mixed with four gallons of water in jeep cans.

The cost of construction of the centralized mixing dump was about $3,000 and two men were required to do the mixing job. Two men were required because of the heavy barrels, and the danger in handling EDB in a concentrated form.

In 1961, insecticide was purchased in two forms: (1) EDB and emulsifier mixed, and (2) EDB, emulsifier and oil. The first mix eliminated handling of the emulsifier, and the second required only that water be added to make the insecticide ready for field use.

The second mix would appear to be the safer and more economical of the two, but this is not the case. The addition of the oil does not appreciably reduce the EDB concentration, nor does this formula eliminate the need for a mixing dump. When large quantities of insecticide are mixed, it is cheaper to use the mix without oil.

In 1961, the cost of using the first mixture was $.21 per gallon, compared to $.26 per gallon for the second mixture. The $.21 per gallon cost includes wages for mixing-dump personnel.

During the 1962 season, two 10,000 gallon tanks were installed at the mixing dump making large bulk purchases of the EDB and oil possible. This resulted in a reduction in purchase price, due to a reduction in shipping costs. Another reduction in cost was possible by hooking the large tanks into the mixing plant for gravity operation. The operation is much safer because the need for handling heavy barrels of EDB in concentrated form has been eliminated.

From the beginning of the project in 1958 and until 1960, insecticide was delivered to the field in individual five-gallon jeep cans. This was effective, but the method was inefficient and had several disadvantages: (1) a man was needed at each mixing dump to add water and seal the jeep cans; (2) several trucks and drivers were required to keep the field crews supplied with a sufficient quantity of insecticide; (3) the time involved in loading, unloading and hauling jeep cans increased the number of cans and drivers needed to insure a sufficient supply; and (4) the loading, hauling, and unloading of cans caused excessive wear, and resulted in the need for replacing or repairing many cans.

In 1960, fuel tankers were acquired to make insecticide delivery more efficient and economical. The hook-up on these tankers was modified so that liquid could be pumped in or out, or circulated. At first, the tankers operated out of the central mixing dump. The tank was first filled with water and then the proper amount of insecticide concentrate added. As the driver drove to the treating area, the load was circulated to complete the mixing of the insecticide. This procedure was modified to eliminate long trips by the tanker. Trucks hauled insecticide concentrate in 50 gallon drums to a location near the treating area where water was available. Since this hauling was done during the day, and the trucks used were also used to haul the treating crews, no additional vehicles were required.

Upon arriving in the treating area, the tanker pulls alongside of can dumps left by packers. The jeep cans would then be refilled and ready for pickup by the packer without additional moving of the cans.

The change to the tankers has been very successful in making insecticide delivery more efficient and safer, and their use has been expanded to cover all but small isolated treating jobs. In expanding their use, sufficient tankers were not available, but it was possible to use flatbed and dump trucks for this work by mounting tanks and pumps on these units. The use of the tankers has several advantages: (1) the need for individual measuring and handling of insecticide concentrate by hand has been eliminated; (2) the need for a man to fill the jeep cans with

water has been eliminated; (3) the number of vehicles and drivers needed to do the job has been greatly reduced; and (4) the repair, and replacement of many jeep cans has been reduced. It is cheaper to use flat bed trucks in place of renting larger tank trucks, due to equipment rental rates. Turn around time was also quicker for the lighter trucks.

In order to avoid costly errors in using the tankers, two points are emphasized; (1) the driver must know the proper amount of water and insecticide concentrate to use in his tanker; and (2) the water must be put in the tanker before the insecticide to avoid the formation of an emulsion which cannot be mixed.

The mixtures used on this project varied. An oil mixture is used in very cold weather. The oil-water mixture is used in warm weather. At first when using the straight oil mixture, 10 gallons of EDB with emulsifier was mixed with 90 gallons of oil. For the water mixture, 29 gallons of EDB with emulsifier was mixed with 110 gallons of oil to give a concentrate for water dilution. This is mixed using 1 gallon of concentrate to 4 gallons of water. In 1963 oil and EDB without emulsifiers were used for winter spraying at a concentration of 1.5# per 5 gallons of fuel oil. Field delivery costs of the straight oil mixture is much higher than for the water mixture.

Vehicle shortages have occurred which made it difficult to supply sufficient tankers to do the insecticide delivery job. In order to do the contract job with fewer tankers and jeep cans, 500 to 1,000 gallon capacity portable tanks were placed on chemical contract treating units. The tankers delivered insecticide to these tanks and the contractor filled his jeep cans. Tank storage reduced the number of trips necessary to keep each contract unit supplied with insecticide and assured the contractor of a sufficient supply.

One problem encountered in handling insecticide was that of sharp edges on jeep can lids. Sharp edges resulted from the lids being tightened and sealed with hatchets, hammers, or rocks. In addition to the obvious wear on the cans, the sharp edges constituted a safety hazard. This problem was eliminated by making special wrenches for tightening the lids and by having the spray crews use the stirrups of their pumps as tools to loosen the lids.

Inspection and Standards

From 1958 until 1961, inspection of the work being done by force account crews was the responsibility of the field foreman, unit supervisor, and the project supervisor, Contract work was checked by contract checkers. The checker's work was checked by the contract unit supervisor and the project supervisor. Work standards and the action to be taken when instances of poor work were found were not established. This resulted in insufficient inspections and lack of uniformity in correcting poor work.

The biggest hindrance to inspections by the people listed above is the demand made by other aspects of their job.

In order to correct this situation, a special checking unit, operating under the project supervisor, was established in the spring of 1961 to check all phases of work. This unit did not relieve the "line" supervisors of their responsibility to see that a satisfactory job was being done. However, the information compiled by this unit was used by all supervisors to insure that all work by their crews was being done properly. This unit checked each crew at least once a week. In addition to the crews' work, insecticide concentration was checked.

Spotting, treating, and survey standards were established at a three percent allowance for missed trees or improperly treated trees. Lines were re-worked if this allowance was exceeded. Later, when the infestation density lessened, the treating standards were based on the philosophy of reducing the density to 0.1 trees per acre. Acres with two hits or greater per acre required a three percent limit; five percent where there were one to two hits; and ten percent where less than one tree/acre. Insecticide standard was set for a specific gravity of 1.008 to 1.014.

Contract checking requirements up to a 100 percent check were shown necessary. The checks were run soon after treating was accomplished and included spotting as well as treating.

It is felt that this substantially increased the work quality, and that this increase in quality more than justifies the cost involved. After 1961 standards were better defined and strengthened, and the checking was expanded to include the work done by contract checkers.

Cost and Work Records

Complete and accurate cost and work records are as essential on insect control projects as they are on all other projects. The effort required to obtain complete and accurate records, increases substantially when the project involves large expenditures over a short period of time by a large decentralized organization. In order to accomplish this job, we found that these records must be kept daily.

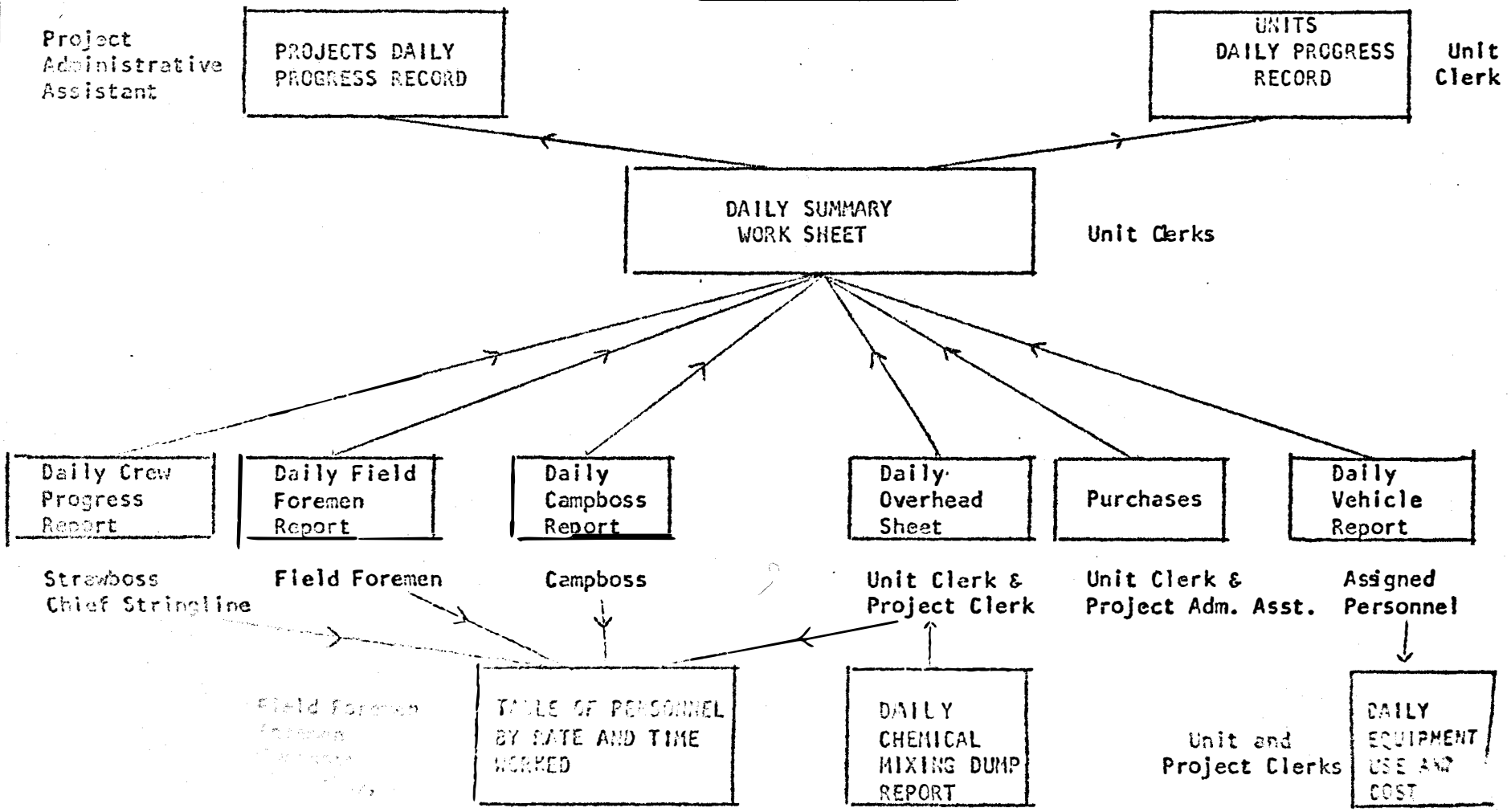
In order to insure that all of the needed items are recorded and to simplify the recording job, several forms have been devised. These consist of daily crew and overhead reports, daily equipment use reports, daily work reports, purchases, and daily summary sheets. Care is taken so that all work accomplished - the work of every person, and the use of every vehicle - is recorded each day. The daily work, crew, and equipment use reports are completed by the "on the ground" supervisors. These

are used in making up the time slips, recording of rental equipment use, and in compiling the daily summary sheet. For the interrelationship of these forms, see the flow chart on the following page: "Relationship of Accounting Forms and Responsibilities."

The daily summary sheet, showing manpower, equipment use, work accomplished, and costs, is compiled by every unit and submitted to the project clerk. This unit sheet is used by the project clerk to make a daily and accumulative project expenditure and accomplishment record. This record is used to check accomplishments against planned work, to make periodic reports, and to control overall expenditures. The latter is the most important and critical use, particularly as deadlines for expenditures approach (such as at the end of the fiscal year), or as the limit of an appropriation is approached.

All of the records are eventually used in evaluating treating methods and in planning future work.

RELATIONSHIP OF ACCOUNTING FORMS AND RESPONSIBILITIES



Equipment and Personnel

Obtaining the large amount of equipment and manpower for the insect control work was a problem every year. In an attempt to reduce the costs of equipment acquisition, personnel recruiting, and personnel training, efforts have been made to exchange equipment and personnel- both permanent and temporary - with other forests. In addition to saving money, the exchange allowed a concentration of manpower and equipment for some jobs that would not have been possible in any other way. The "Operation Pushover" job in 1960 is a prime example. It provided a full summer's work for forest laborers who continued work on a different beetle on the Bridger National Forest after July.

A large amount of equipment and supplies (power plants, tanks, pumps, beds, bedding, canvas, power tools, etc.) has been acquired from the armed forces surplus disposal program. Surplus acquisition has saved thousands of dollars, and has made possible the acquisition of some items that could not have been purchased new, notwithstanding their desirability.

Obtaining a sufficient number of vehicles was an acute problem. Every year the project used Forest Service, GSA, and personal vehicles to get the job done. Each season we exhausted the supply available from the Forest Service Equipment Section and those available from GSA under existing regulations. During 1962 through 1964 favorable rental rates and good equipment was available to the project from private sources.

Personnel recruiting for a work force of 200-500 men is a big job. Insect control personnel screened as many as 1,000 applications from January through May. This job has usually been done in two phases. The first is to review all of the past year's employees, and re-offer a job to those whose work was satisfactory. This re-employment results in a substantial saving in training time.

The second phase is to screen the current year's applicants to fill the remaining needs of insect control work projects. Except in filling clerical or overhead positions, we have found that personal interviews are not of sufficient value to warrant making them. The size of this job is consistently underestimated by personnel who have not been involved with hiring a work force of this size.

Planning and Evaluation

Planning and report writing was a part-time job the first few years of the project. As a result, reports and planning were done at the last minute. Starting in 1962 one to three full-time employees were assigned to the project throughout the year.

Camp Construction, Security, and Maintenance

As evidenced by the figures in Table II, the cost of camp items is considerable. Camp construction costs cannot be avoided but savings can be effected by using existing district facilities where they are available, and by using contract treating where it will be economical and in line with good management.

Camp security costs have been reduced on the forest by concentrating most of the property (cans, tools, saddles, bedding, etc.) at a central camp. This eliminates the need for watchmen at all but one camp during the non-treating seasons. Repairmen or other workmen do the camp watchmen's job along with other duties.

Road Construction and Maintenance

Each year the use of project funds has been necessary to accomplish all or part of this job. A total of $125,418 has been spent for this work since 1958.

It is felt that much of this work by insect control would not have been necessary had the planned forest road system for the area been completed at or before the time insect control work was being done. This, of course, was impossible with the funds available. Snow removal and some maintenance and construction work would have to be done by insect control even if the system were complete.

In order to help reduce road work done by insect control, work on the road system with FR&T funds in this area was given priority. The construction of the Red Mt.-Bullock Park road is an example of this. Approximately 70 miles of work road has been built by insect control funds during the project.

Many more miles of old tie logging and woods roads were opened up for insect control use.

Contracts

Contracts were awarded for treating trees, for use of equipment and horses; and supplying propane, oil, and perishable food. Considering the number of contracts that have been awarded, very few problems have been encountered. Listed below are some of the significant problems encountered and changes made.

1. The subsistance bid specifications concerning size, form and quality were so vague that the prospective bidders were at a loss as to exactly what to base their bids on. This was thought to have resulted in higher bid prices or in the government receiving merchandise with a lower quality than desired or in an inconvenient

form. This problem was corrected by a more thorough description of the size, form and quality of the bid items.

2. On many of the original contracts, the government usually furnished several items. We have found that it is more economical and simplifies contract administration when all items or nearly all items are furnished by the contractor. An example of this is our horse contracts. In the original contracts we furnished saddles, bridles, pads, hay and grain. In most of the latest contracts we are furnishing none of these items.

3. Contract treating is a very complicated undertaking. Contractors are paid on a piece basis and therefore are after quantity production at the expense of quality. Generally more retreatment in following seasons is necessary on contract areas than on force account areas.

   Surveys can not be counted upon to give an accurate estimate of the number of trees on a given area; therefore, when an area is bid upon and paid for "by the tree" the contractor may have a deficit or a surplus. In either case, problems arise. With too few trees, the contractor has to spot a larger area with less paying production. With more trees per acre than estimated, the Forest Service calculations on fund allotments are too small to cover the costs; and some contractors were not able to do the extra work in the allotted time.

   With contractors who are losing money or are not capable of doing the required job, administration costs are very high. With short spring treating seasons, holding a contractor in default will not allow the job to be completed by another contractor.

   Contractors have been paid by the tree, by the acre for spotting and treating, and by a combination of acres and trees. It is felt that the combination of per acre cost with a per tree cost is best. This combination will guarantee the contractor payment to cover setting-up and spotting costs as well as treating costs.

   Administration costs are much higher on areas with scattered infestation. It seems that contractors will do a good job in heavy infestations and the same contractor a poor job when spotting is slow and hard.

4. Contracts for horses were improved in 1964 by having the horses delivered and picked up on the road where crews were located. This change allowed the packer to be with his crew for a full shift and contributed greatly to the crew efficiency.

SAFETY

Safety is always a problem on large projects in which a large number of men are hired for a short period. To fill manpower needs it is necessary to employ a large number of transients and inexperienced people. This situation has required an intensive continuing safety program.

The insect control projects on the forest have been fortunate in having high caliber safety officers to see that the forest and project safety programs were implemented. This has resulted in an excellent safety record by insect control.

Listed below is a summary of the accident occurrence and working time on the forest's insect control projects.

TABLE V - PERSONNEL ACCIDENTS

Year	First Aid	Medical Expense	Lost Time	Total	Man Hours	Man Hours per Work Accident
1958	5	-	-	5	60,056	12,011
1959	7	6	-	13	87,520	6,732
1960	20	18	-	38	131,120	3,451
1961	34	7	-	41	189,520	4,622
1962	11	13	-	24	160,296	6,679
1963	20	6	-	26	96,888	3,726
1964	1	2	-	3	27,944	9,314
1965	0	1	-	1	11,256	11,256
Total	98	53	-	151	764,600	5,064 (average)

TABLE VI - VEHICLE ACCIDENTS

Year	$25 or Less Damage	$25 to $100 Damage	$100 to $200 Damage	Total	Miles Use
1958	-	-	1	1	51,000
1959	2	-	-	2	101,000
1960	2	-	-	2	131,000
1961	2	1	2	5	180,000
1962	-	-	-	-	235,000
1963	-	-	-	-	72,900
1964	-	1	0	0	17,000
1965	-	-	-	-	10,000
*Total	6	2	3	10	797,900

*Total does not include 1963.

MULTIPLE USE

In all phases of the insect control operation multiple use coordination was considered. Conflicts with other uses were avoided. The edge effect created by operation pushover increased the wildlife habitat. In addition, forage on the area has increased and may provide additional temporary range for domestic livestock.

Some erosion problems have been created on insect control access roads. However, a survey of the extent of the problem has been made, and it is planned to provide adequate erosion measures on these roads in the 1966 season.

Roads built to serve the I.C. project now provide access for many other Forest uses.

SUMMARY AND RECOMMENDATIONS

The I.C. job turned out to be much greater than anticipated. One object of this history is to pass on some lessons learned by the many people connected with the project.

Following are some of the major pitfalls and their solutions:

At first, planning the year's work was just another rush job done in the spring. Thus adequate controls and plans were not developed. This was solved by keeping foresters year-long for reports and planning.

Another cause of poor controls was the temporary detailing of clerks to the project for a short period. Usually by the time a clerk became acquainted with the project, the season was well along. It is important to keep a clerk or forester with large projects throughout the life of the project, to furnish continuity to the bookkeeping and operation.

Forest Service vehicle fleets were not adequate. Other sources must be sought immediately. This problem was solved with GSA, and private rental fleets.

Large project camp and field operations require expensive utilities. Government surplus equipment from generators to bombcarriers helped supply the need, saving many dollars of project funds. Available military depots near the forest allowed screening surplus equipment at little cost.

In 1965 isolated areas of infestations were treated from Burnt Fork on the east to the Blacksfork on the west. By that fall, a flight over the entire slope showed a vertually "clean" forest. Only three areas with over .5 trees per acre remained. They coincided with areas treated early in the 1936 and 1958 projects.

It has been recommended that one area be treated with B.H.C. because of its steep slopes; another salvage logged, and the third kept under surveillance in 1966 since it is located mainly on private lands.

A yearly survey of the high risk areas and maintanance spraying of any threatening spots are recommended.

In addition, it is recommended that a sanitation strip be made around the perimeter of the operation pushover area. This will protect the regeneration from infestation by surrounding mistletoe stands.

APPENDIX

APPENDIX

ESTIMATED RESOURCES LOST AND THREATENED

From timber sale data, it was determined that an average of 200 board feet of timber per infested tree was lost during the early stages of the infestation. As the larger diameter classes were eliminated by the beetle during the subsequent stages, there was a corresponding decrease in the average loss per infested tree.

TABLE 7 - PERCENT OF EACH DIAMETER CLASS KILLED OR INFESTED PRIOR TO 1958 BASED ON REPRESENTATIVE SAMPLING OF EACH UNIT.

Unit	Diameter Class 6	8	10	12	14	16	18	20	22	24	Percent Total Stand
	Percentage of Each Diameter Class										
1. Hoop Lake*	10	15	20	21	20	12	9	3	5	-	14
2. Henry's Fork	3	8	13	18	25	7	14	43	100	-	7
3. Bridger Lake	4	5	9	15	23	20	13	4	100	9	8
4. Smith-Gilbert	9	14	21	23	10	35	35	23	9	-	15
5. Hewinta	2	6	11	23	18	29	33	44	100	38	8
6. Horse Creek	3	7	5	6	11	17	33	27	37	33	6
7. E. Fk. Bl. Fk. GS	4	8	14	14	12	15	13	10	100	2	10
8. Bl. Fk. Comm.	1	1	2	3	4	9	0	14	10	22	2
9. Lily Lake	2	2	4	2	3	10	-	-	-	-	2
10. Cow Hollow	8	5	8	15	23	-	-	-	-	-	8

*Oldest part of epidemic. Insects less selective and remaining large diameter trees probably more resistant.

TABLE 8 - ESTIMATED TIMBER LOSSES FROM SURVEY INFORMATION

Period	Trees Treated or Infested	Vol. Loss Per Tree	Total M Bd. Ft.
1931 - 1936	168,000	200	33,600
1941 - 1944	74,000	170	12,580
1948 - 1950	110,000	130	14,300
1956	100,000	110	11,000
1957	108,660	100	10,866
1958	191,971	90	17,277
1959	199,166	75	14,937
1960	304,611	64.5	19,647
1961	380,000	64.5	24,510
1962	60,336	64.5	3,892
1963	78,000	64.5	5,031
1964	30,700	64.5	1,980
1965	3,419	64.5	182
TOTAL	1,808,863		169,802

Since 1931 there was an estimated timber loss of ~~163~~ 169.8 million board feet of sawtimber in the survey area only. (Table 8) This is a conservative estimate as it does not include trees outside of surveyed areas and infestations during years when there was no treating or survey activity. Assigning a stumpage value of $5 per MBM, the stumpage dollar loss from insect activity alone amounts to $848,100. The manufacturing and harvesting loss in equipment and payrolls is much greater.

The wood characteristics of lodgepole pine give the species a high potential for use in sawed or fiber products. The small tree size hinders use of the species as lumber, but this disadvantage can, and is being overcome by better utilization standards and manufacturing processes such as edge glueing.

Proposals for utilization of this resource will make substantial contributions to local community development. Past and present timber losses are detrimental to these programs.

TABLE 9 - TOTAL EXPENDITURES BY TREATING METHOD, CALENDAR YEAR, AND COST ELEMENTS

Year	No. of Trees Treated	No. of Acres Treated	Net Cost of Treating	909 Assessment	Evaluation and Planning	Project Overhead	Camp Const. Maint. and Security	Road Const. & Maint.	Total Cost of Operation
Chemical - Force Account									
1958	17,948	27,978	$ 178,337	$ 17,877		$ 5,201	$141,180	$21,937	$ [illegible]
1959	49,838	22,520	286,955	32,381	$ 5,207	7,959	2,097	13,271	[illegible]
1960	110,317	36,183	429,871	27,667	16,067	11,949	31,163	6,803	[illegible]
1961	89,082	18,624	330,177	31,206	6,296	11,967	41,790	19,332	[illegible]
1962	66,933	32,411	463,959	25,828	13,914	21,007	13,738	8,126	[illegible]
1963	45,972	82,299	304,310	24,880	13,300	11,958	4,870	195	359,513
1964	6,353	33,078	68,300*	7,000	16,366	2,470	1,721	800	96,657
1965	3,419	35,030	26,247	8,661	1,816	4,303	12,167**	1,310	54,504
Total	389,862	288,123	$2,088,156	$175,500	$72,966	$76,814	$248,731	$71,777	$2,733,944
								Cost/tree	7.01
								Cost/acre	9.49

* Includes $5,000 of EDB stocks

** Includes $8,718 property removal to Clearfield, $2,187 for raising camps which 80% complete to date: Dec.1,[illegible]

Chemical - Contract									
1958	34,606	14,022	$ 136,379	$ 8,899		690	$ 18,711	$16,776	$ 181,455
1959	25,226	17,240	107,459	12,166	$ 1,950	$ 2,980	786	4,969	130,310
1960	No contract work done								
1961	18,323	9,292	59,805	2,644	1,196	2,278	2,488	3,679	72,090
1962	100,890	52,235	368,286	6,987	3,764	5,783	3,251	2,132	390,203
1963	35,416	25,568	119,461	10,664	4,293	6,304	1,275	934	142,931
1964	6,208	6,420	60,319*	5,000	---	710	100	------	66,129
Total	220,669	124,777	$ 851,709	$ 46,360	$ 11,203	$18,745	$26,611	$28,490	$983,118
								Cost/tree	4.46
								Cost/acre	7.88

Year	No. of Trees Treated	No. of Acres Treated	Net Cost of Treating	909 Assessment	Evaluation and Planning	Project Overhead	Camp Const., Maint, and Security	Road Const.& Maint.	Total Cost of Operation
Burning - Standing - Force Account									
1960	75		$ 165						$ 165
1961	7,217	448	15,253	$1,593	275	$1,398	$1,184	$ 763	20,468
1962	9,098	1,184	31,880	1,672	901	1,471	92	473	36,489
1962 APW	2,541	1,451	17,249		267	977			18,513
Total	18,931	3,083	$64,547	$3,265	$1,443	$3,866	$1,276	$1,238	$75,635
								Cost/tree	3.995
								Cost/acre	24.533
Operation Pushover - Force Account									
1960	54,922	1,016	$ 69,980	$4,494	$3,165	$ 1,941	$ 5,063	$ 1,850	$ 86,493
1961	28,547	762	129,111	7,815	5,586	15,921	10,799	23,621	192,853
1963*	-----	665	1,437	200	100	300	----	-----	2,037
Total	83,469	2,443	$200,528	$12,509	$8,851	$18,162	$15,862	$25,471	$281,383
								Cost/tree	3.37
								Cost/acre	115.18
Logging - Force Account									
1961	10,459	262	$ 37,664	$ 4,613	$ 753	$ 2,564	$ 2,690	$10,958	$ 59,242
1963	----	---	1,336	100	----	-----	-----	------	1,436
Total	10,459	262	$ 39,000	$ 4,713	$ 753	$ 2,564	$ 2,690	$10,958	$ 60,678
								Cost/tree	5.80
								Cost/acre	231.60

* Burning remaining log piles

Year	No. of Trees Treated	No. of Acres Treated	Net Cost of Treating	909 Assessment	Evaluation and Planning	Project Overhead	Camp Const. Maint. and Security	Road Const. & Maint.	Total Cost of Operation
Felling and Burning - Force Account									
1961	1,020	136	$3,887	$ 425	$ 78	$ 148	$ 681	$ 289	$5,458
1962 APW	326	93	2,097	---	--	--	--	---	2,097
Total	1,346	229	$ 5,984	$ 425	$ 78	$ 148	$ 681	$ 239	$7,555
								Cost/tree	5.614
								Cost/acre	32.996
Felling and Burning - Contract									
1961	753	70	2,312	84	46	88	101	142	2,773
1962	10,754	2,653	51,186	1,226	661	997	558	392	55,020
Total	11,507	2,723	$ 53,498	$1,310	$ 707	$ 1,085	$ 659	$ 534	$57,793
								Cost/tree	5.022
								Cost/acre	21.224
Survey - Force Account									
1958				$ 1,433	$14,295	$ 417	$11,316	$1,759	$ 29,220
1959				1,779	16,053	445	117	742	19,136
1960				949	14,774	410	1,069	233	17,435
1961				1,879	17,805	985	2,504	964	24,137
1962			$ 9,626	706	380	3,763	83	261	14,819
1963 (includes Kamas R.D.)			7,752	950	300	574	------	---	9,576
1964			846	127	100	50	------	---	1,123
1965			1,611	-----	100	50	------	---	1,761
Total			$19,835	$ 7,823	$63,807	$ 6,694	$15,089	$3,959	$117,207

Explanation of cost elements: Table 2, Page 12

TABLE 10 - TOTAL TREES AND ACRES TREATED BY RANGER DISTRICTS - WASATCH NATIONAL FOREST 1958 - 1965

Calendar Year	Mt. View RD		Evanston RD		Kamas RD		Total	
	Trees	Acres	Trees	Acres	Trees	Acres	Trees	Acres
1958	50,872	39,500	1,682	2,500	-----	------	52,554	42,000
1959	74,372	39,328	428	132	264	300	75,064	39,760
1960	163,886	36,774	162	75	1,266	350	165,314	37,199
1961	153,566	28,844	148	50	1,687	700	155,401	29,594
1962	159,461	75,652	8,097	5,609	22,984	8,766	190,542	90,027
1963	81,238	107,667	150	200	-----	------	81,388	107,867
1964	10,893	36,627	209	611	1,459	2,260	12,561	39,498
1965	2,827	34,590	46	100	546	340	3,419	35,030
Total	697,115	398,982	10,922	9,277	28,206	12,716	736,243	420,975